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İSMAİL ÖZDEN

MASTERS THESIS

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GEBZE

2019

GEBZE TEKNİK ÜNİVERSİTESİ	**YÜKSEK LİSANS JÜRİ ONAY FORMU**

GTÜ Sosyal Bilimler Enstitüsü Yönetim Kurulu'nun 01/07/2019 tarih ve 2019/18 sayılı kararıyla oluşturulan jüri tarafından 10/10/2019 tarihinde tez savunma sınavı yapılan İsmail ÖZDEN'in tez çalışması Strateji Bilimi Anabilim Dalında YÜKSEK LİSANS tezi olarak kabul edilmiştir.

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SUMMARY

The aim of this study is to test the presence of low risk-high return anomaly (Low Volatility Anomaly) in the Borsa İstanbul BIST 100 index. While a positive relationship between high risk and high return is expected in the financial markets, the low risk-high return relationship is not expected. Because the less risk in a portfolio, the higher the demand is expected for that portfolio, all else equal. It is usual for financial markets that the expected yields fall with increasing demand. In other words, the lower the risk of the portfolio, the lower the expected return. Therefore, the observation of low risk and high return is considered as an anomaly for financial markets and is called "Low Volatility Anomaly" or "Low Beta Anomaly".

This study investigates the existence of "Low Volatility Anomaly" in Borsa İstanbul, which has not been studied earlier. For this purpose, in the first part of the study, the information about the beta coefficient, which is one of the most frequently used risk criteria in the stock market, its calculation, the importance of the beta coefficient and the past studies on the subject and the results of these studies are explained. In the other part of the study, quarterly average returns and beta values for the selected periods were calculated by using the data of stocks included in the Borsa İstanbul BIST 100 index between 2002 and 2013. As a result of these calculations, ten different portfolios are classified according to the risk they contain, and the average risk and return of each portfolio is calculated. By comparing the risks and returns of these portfolios, the presence of low beta anomaly was tested in Borsa İstanbul.

In the light of the analyzes, it is established that some portfolios with low-risk yield higher returns than many portfolios with higher risk. Similar results were obtained in the robustness tests performed by changing the frequency of the period. As a result, the research shows the presence of low beta anomaly in Borsa İstanbul.

Keywords: low volatility anomaly, low beta anomaly, low risk-high return

ÖZET

Bu çalışmanın amacı Borsa İstanbul BIST 100 endeksinde düşük risk- yüksek getiri anomalisinin (Low Volatility Anomaly) olup olmadığının test edilmesine yöneliktir. Finansal piyasalarda yüksek risk ile yüksek getiri arasında aynı yönlü bir ilişki beklenirken, düşük risk-yüksek getiri ilişkisi beklenen bir durum değildir. Çünkü bir portfoyde risk ne kadar az ise o portfoye olan talep de o kadar artar. Talebin artması ile beraber beklenen getirinin düşmesi finansal piyasalar için olağan bir durumdur. Yani portfoyun riski ne kadar düşükse beklenen getiri de o kadar düşük olacaktır. Bu nedenle düşük risk ve yüksek getirinin gözlemlenmesi finansal piyasalar için bir anomali olarak nitelendirilmektedirve "Düşük OynaklıkAnomalisi" (Low Volatility Anomaly) veya "Düşük Beta Anomalisi" (Low Beta Anomaly) olarak adlandırılmaktadır.

Bu çalışma Borsa İstanbul özelinde daha önce bu yönde bir çalışma yapılmamış olan "Düşük Oynaklık Anomalisi" varlığını araştırmaktadır. Bu amaçla, çalışmanın birinci bölümünde hisse senedi piyasasında en sık başvurulan risk ölçütlerinden olan beta katsayısı ve bu katsayının hesaplanmasına yönelik bilgiler, beta katsayısının önemi ve konu ile ilgili olarak geçmişte yapılan çalışmalar ve bu çalışmaların sonuçları anlatılmaktadır. Çalışmanın diğer bölümünde ise, 2002-2013 yılları arasında, Borsa İstanbul 100 endeksinde yer alan hisse senetlerine ait veriler kullanılarak, seçilen dönemler için üç aylık ortalama getiri ve beta değerleri hesaplanmıştır. Bu hesaplamalardan faydanılarak içerdikleri riske göre sıralanan on ayrı portföy oluşturmuştur ve her portföyün risk ve getiri ortalamaları hesaplanmıştır. Bu portföylerin risk ve getirileri karşılaştırılarak düşük beta anomalisinin varlığı Borsa İstanbul özelinde test edilmiştir.

Yapılan analizler ışığında düşük riske sahip bazı portföylerin kendisinden daha riskli bir çok portföyden daha yüksek getiri sağladığı tesbit edilmiştir. Elde edilen bulguların sıhhatini test etmek üzere, periyot sıklığı değiştirilerek yapılan sağlamlık teslerinde de benzer sonuçlar elde edilmiştir. Sonuç olarak, yapılan araştırma Borsa İstanbul özelinde düşük beta anomalisinin varlığını göstermektedir.

Keywords: düşük oynaklık anomalisi, düşük beta anomalisi,düşük risk-yüksek getiri

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	**Explanation**
BIST	Borsa İstanbul
BIST 100	The main index for Borsa İstanbul consists of 100 shares
CAPM	Capital Asset Pricing Model
JSE	Johannesburg Stock Market
ISE	Istanbul Stock Exchange

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1. INTRODUCTION

As individuals aim to use current savings for future income, they want to yield high returns on their savings. However, the probabilities of not achieving the maximum profits that are expected to be achieved at the end of the investment are an essential issue that must be accepted by investors. For this reason, stockholders who want to evaluate their savings in capital markets should not ignore the concept of risk. In that case, the investors should pay attention to the studies on the relationship between risk and return when investing. Determining the relationship between risk and return will enable investors to make better choices and to achieve more profitable outcomes.

It is assumed that there is a positive relationship between risk and expected return in financial markets. In other words, if the risk increases in a portfolio, the return is expected to increase, and if the risk decreases, the return is expected to decrease. In other words, the less the risk with the same expected return, the higher the demand for it. As demand increases, the yield is expected to decline. So low risk implies a low expected return. However, many contradicting observations are documented in financial markets, which is called "Low Volatility Anomaly".

The reason for underlying defining existence of low volatile portfolios with high expected returns as an anomaly is simple: if a portfolio is less risky with higher expected returns than its counterparts, it is likely that investors will demand that portfolios more ex-ante. The increased demand will increase the prices of assets in the collection and because of the increase in prices will result in a lower expected return for that portfolio. As a result, low return is expected with little risk in financial markets. Therefore, the observed low risk and high yields of the financial markets and is regarded as an anomaly for "Low Volatility to Anomaly" (Low Volatility Anomaly) or "Low Beta Anomaly" (Low Beta Anomaly) is called.

I investigate the relation between returns and low volatility effect in the Borsa İstanbul BIST 100 index for the ten years between 2002 and 2013. Each year is divided into four quarters with 3-month return and beta values. Four tables for one year, including 100 stocks for each quarter, were prepared. Thus, for the 12-year data set, 48 tables are ready, with the same fields, each consisting of 100 stocks. Each table is

sorted in ascending order by beta value. Each quarter sequence composed of 10 portfolios and each collection includes ten shares. As a result, the beta and average returns of each portfolio in the specified period are recursively recalculated.

Fort risk measure, we use the beta coefficient (Başoğlu, 2001). The beta coefficient is used to estimate the risks of a stock since it shows how sensitive a stock's assets are to changes in the market. However, whether the beta coefficient is a good predictor is continuously tested by empirical studies on various exchanges. It has been tried to measure the stability of the beta coefficients by calculating the beta coefficients calculated using the returns in different periods for the same stock. To find out whether the beta coefficient is a good predictor in a stock market, it is crucial to work on the stability of the ratio.

When the beta coefficient and return graph are examined in 2, 3, 4, 6-year periods in portfolios consisting of 10 stocks, it is seen that the areas with low beta coefficients and high returns dominate the graph in the portfolios.

For example, in this graph, which is the beta and return curve of 10 portfolios, it is observed that seven portfolios dominate the remaining three collections, which can be observed as the return of beta increases.

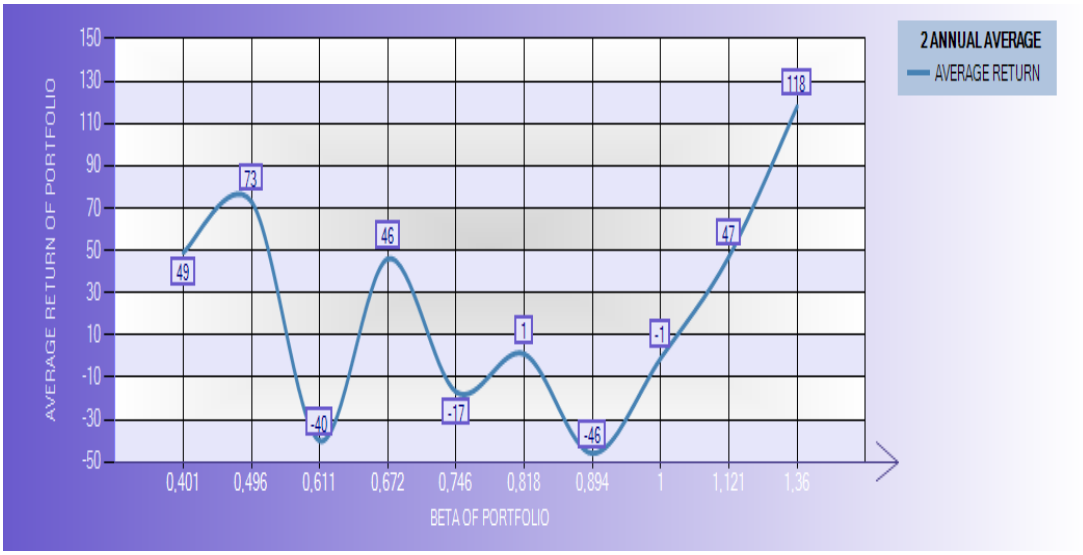


Figure 1.1: 2-year average return and beta chart of portfolios consisting of 10 stocks.

Before this study, there was no research testing presence of "Low Volatility Anomaly" in Borsa İstanbul. In this study, "Low Volatility Anomaly" is examined, and its presence is determined in Borsa İstanbul BIST 100 index between 2002 and 2013.

2. LITERATURE REVIEW

Nilsson (Olivia Nilsson , 2019) examined the low beta anomaly and its possible presence in the Swedish stock exchange. They also investigated whether it is possible to implement a low beta investment strategy to exploit the anomaly. The findings of the article indicate that low beta anomaly exists in the Swedish market and continues to control Fama-Frenchfactors(EF Fama, 1992).

Kenneth Østnes and Håkon Hafskjær investigated a low volatility phenomenon in the Norwegian stock market for the period 1981 – 2012 by utilizing the methodology developed by Ang et al. (Ang, 2006). They established that there is no low volatility anomaly in Norway, finding which is consistent with the Capital Asset Pricing Model (CAPM) theory. According to the findings based on their studies, a positive correlation is located between the selected periodic risk and expected return in the Norwegian stock market (Kenneth Østnes, Håkon Hafskjær, 2013).

David C. Blitz and Pim Van Vliet (Vliet, 2007)revealed evidence that low volatility equals high returns. The annual alpha spread of global low versus high volatility decile portfolios amounts to 12% over the 1986-2006 period. They also observed each volatility effect separately in the US, European, and Japanese markets. They also found that the volatility effect cannot be explained by other well-known effects such as value and size. The study shows that stock investors overpay for risky stocks. Possible explanations of this phenomenon include (i) leverage constraints, (ii) inefficient two-stage investment process, and (iii) behavioral bias of private investors. In order to take advantage of the volatility in practice, it turns out that investors need to include low-risk stocks as a separate asset class during the strategic asset allocation stage of their investment processes.

Baker and Haugen (Haugen, 2012) confirmed the presence of the low volatility anomaly in 21 developed and 12 emerging markets between 1990 and 2011. Early empirical tests of volatility anomaly focused on a non-specific, cumulative risk. Heins (Heins, 1972) and Haugen (Heins, Robert A. Haugen and A. James, 1975)first showed that firms with low standard deviation perform better than those with a high standard deviation. In 2012 Baker and Haugenand 2007 Blitz and Vliet showed that this effect exists in stock markets worldwide. While these results are surprising, it is not clear

what the outcome is. Total risk is positively correlated with specific risk among stocks. Instead, most articles focus directly on a particular risk.

Tarryn (Tarryn, 2016) analyzed Low Beta Anomaly using South African data in his research. The relationship between market risk and excessive return in the Johannesburg Stock Market (JSE) for the period 1992-2014 was investigated. According to him by utilizing the mimicking portfolio methodology employed by Fama and French(Fama, 1993) it is evident that in accordance with the internationally documented outperformance of low beta shares relative to high beta shares is present on Johannesburg Stock Market (JSE). An interesting finding of this study, high-beta shares, the Internet bubble in 1999, and the trend is in the lower-performing share in the turbulent market conditions, such as low-beta beginning in 2008, the Global Financial Crisis, this in line with many papers suggesting behavioral biases as an explanation for the Low Beta Anomaly.

For Asian-Pacific stock markets, Ho et al.(Y.K. Ho, 1990), Wong and Tan (K.A. Wong, 1991), andCheung et al.(Y.L. Cheung, 1993)examined the relations between stock returns andthe various statistical measures of stock returns on the Hong Kong, Singapore, Korea and Taiwan stock markets, respectively. Wong and Tan analyzed the relationship between risk and return on the Singapore stock exchange (K.A. Wong, M.L. Tan, 1991). They found that for the weekly yield of 72 stocks from 1980 to 1985, CAPM's applicability in the pricing of Singapore securities seemed rather weak. In general, the applicability of CAPM appears weak. Chui and Wei (A. Chui, 1998)investigated the risk-return relation on five Pacific-Basin emerging markets: Hong Kong, Korea, Malaysia, Taiwan and Thailand. They found a linear relationship between average stock return and market beta. Furthermore, they found that stock returns are more related to size effect and book-to-market ratio. However, Wong and Tan (K.A. Wong, 1991), examining the relationship between risk and return in the Singapore market with weekly data, stated that there is a nonlinear relationship between systematic risk and return.

Yen-Sheng Huang (Huang, 1997) investigated the risk-return relationship for stocks traded on the Taiwan Stock Exchange in 1971-93. Contrary to the predictions of CAPM, the results were found to have an inverse relationship between return and systematic risk, unique risk, and total risk, respectively. The results remain unchanged

when the firm size is controlled. Moreover, the inverse risk-return relationship was not associated with monthly seasonality.

According to Sharpe(Sharpe, 1964), Lintner (Lintner, 1965) and Black(Black, 1972), there is a positive relationship between the expected return and betas, and only the market beta is a risk factor in explaining the expected returns for horizontal cross-section variation. Since the expected return is a linear function of the betas, the market cross-section is sufficient to estimate the expected return. According to Lintner(Lintner, 1965), who has not studied the relationship between systematic risk and return rates of assets, there is a positive relationship between the systematic risk of existence and the rate of return.

Black, Jensen and Scholes (Black F. J., 1972) stated that there is a positive relationship between systematic risk and return, and that this relationship is not the same as the risk-equity relationship expressed by the securities market line. Assets with low risk have a return on expectations, while assets with high systemic risk have a lower return rate than the market return of the securities market.

According to Sharpe and Cooper (Cooper, 1972) , the calculated beta coefficients of a single stock acted in unsteady over time. There is a non-linear but positive relationship between risk and return.

Roll (Roll, 1977) has brought a new perspective to the CAPM with a critical approach to the work of testing CAPM. According to Roll, a linear relationship between expected return and risk depends on the effectiveness of the market portfolio. The linearity between betas and returns is a natural result of market portfolio effectiveness. It has been argued that the work of the CAPM can not be tested with the use of narrower market portfolios instead of the actual market portfolio. According to Roll, even if the market portfolio is ineffective, it is possible that a linear relationship between risk and return can be determined in the portfolio used instead of the market portfolio.

Reinganum (Reinganum, 1981), Lakonishok, Shapiro (Josef Lakonishok, 1986) , and Fama, French(EF Fama, 1992), while Black, Jensen, Scholes (Black F. J., 1972) and Fama and MacBeth(EF Fama J. M., 1973)stated that there was a weak relationship between average returns and betas in the period 1926-1968. From 1963 to 1990 they

noted that this simple relationship was lost. According to Fama and French, the results do not support the view that average stock returns are related to beta in appositive direction. Beta coefficient does not have an effect on average return explanation, variables explaining rate of return are market size/book value change with firm size variance.

Pettengill, Sundaram and Mahur (Pettengill, 1995) examined the conditional risk-return relationship using the actual monthly market rates of return. Investigators pointed out that the relationship between risk and return is positive when the market overturn (when the stock or portfolio turnover is above the index return) is positive, and when the market overturn is negative, the risk and return relationship is negative. Bark (Bark, 1991) rejected the positive relationship between risk and return in the study of the Korean market and concluded that risk (non-systematic risk) plays a crucial role in assessing risky assets.

In the Hong Kong market study, Lam (Lam, 2001)concluded that there was a negative correlation between returns and betas during the period when the market was up and during periods when the market was falling, and that the conditional CAPM was a valid pricing model in the Hong Kong market.

In the study of Khuzwayo's (Khuzwayo, 2015), "Understanding the low volatility anomaly in the South African equity market", a low volatility anomaly was observed in the South African market. Findings about the potential causes of the anomaly in the international literature were found to be widespread in the South African market.

Rémy Jacqmin's "An analysis of the low-volatility anomaly"(Jacqmin, 2016) study tested the presence of volatility anomalies in large US stock samples between 1994 and 2015. He divides the example into two 11-year periods and found that low volatility stocks outperform high volatility stocks over the two periods. Rémy Jacqmin also investigated the causes of low volatility anomaly. First, the volatility effect is highly correlated with the profitability factor of the enterprise. Therefore, there is a strong relationship between volatility and business profitability. The second is that behavioral finance may play a role in low volatility anomaly.

Gordon Y.N Tang and Wai Cheong Shum (Gordon Y.N Tang, 2004) examined the relationship between stock risk and return on the Singapore stock exchanges from April 1986 to December 1998. During these periods, they found that the risk-return relationship was not linear. Also, the relationship between beta and return is found to be a significant positive correlation in the emerging market and a meaningful negative relationship in the descending market.

In their articles, Frazzini and Pederson (Frazzini, 2014)find that high-beta portfolios have lower alphas and smaller Sharpe ratios for stocks traded both in the US and international markets than in low-beta collections. They find that the security market line is more linear than predicted by the CAPM model in the US market and eighteen of the nineteen international markets tested. And they argue that this is due to funding constraints that investors face and then cannot invest in the portfolio that has the highest return per risk unit and then cannot raise their portfolios to suit their risk preferences.

George Abo Al Ahad and Denis Gerzic (Gerzic, 2016) investigated the relationship between beta and return between 1999 and 2016, including the Dot-Com Bubble and the 2008 financial crises on the Swedish stock exchange. They concluded that high beta stocks in the Swedish stock market from 1999-2016 did not perform better than low beta stocks. They think the relationship between beta and return is due to market inefficiencies and irrational investments. In this study, they found that the use of beta as the only risk factor to explain the expected returns of stocks or portfolios was not correct.

Anton Brodén and Jonathan Fransson (Fransson, 2015)find low-risk anomaly present at NASDAQ OMX Stockholm from January 2005 to December 2014. Both value-weighted and equally-weighted portfolios are used to obtain Jensen's alpha and Sharpe Ratio and can reach the same conclusion. Low-risk anomaly exists in all markets outside the stage during the 2007-2008 bear market. It is concluded that the right investment opportunity is to invest in low-risk stocks.

Kurtay (Kurtay, 1992) found that there is a linear relationship between the return rate and risk in the Borsa İstanbul within 48 months, but this relationship cannot be

determined when the observation period is shortened, and beta does not have the power to decide the return rates of stocks in the future periods.

There are also studies that test CAPM in the ISE. Unvan (Unvan, 1989) found a significant positive relationship between the average returns of stocks and systematic risks. The fact that stocks with systemic risks greater than 1 provides more risk premiums than other stocks is accepted as an indicator of this. However, the estimated monthly risk-free interest rate was smaller than the risk-free interest rate in the same period.

In the study of (Yalçıner, 2006) , according to the results of the regression models analysis in which the relationship between risk and return is examined, there is a positive relationship between risk and return. The rate of return of stocks with a high systematic risk is higher than the rate of return of stocks with a small systematic risk. It is seen that more returns can be obtained by undertaking more risks during the research period. According to the Fama and MacBeth Model results, in which the linearity of the relationship between risk and return is tested, the relationship between the risk and return of the asset is positive. However on systematic risk as well as on non-systematic risk-return has an important power.

3. DATA AND METHODOLOGY

3.1. Borsa İstanbul

As of the end of 2002, the number of companies traded on Borsa İstanbul; There are a total of 288, 262 in the National Market, 14 in the Regional Markets and 12 in the Detention Market. Shares There are no companies traded in the New Companies Market.

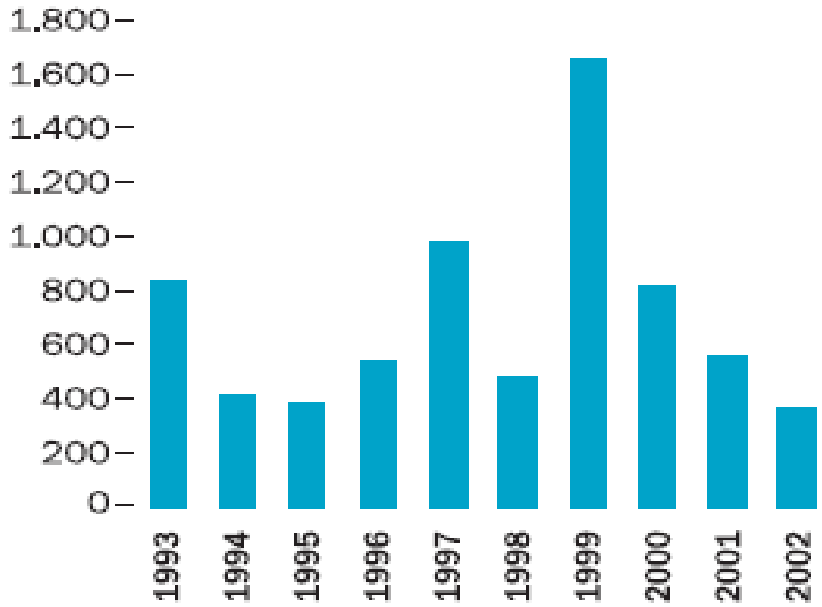


Figure 3.1: BIST 100 Index in USD

Source: Borsa İstanbul , 2002

The total transaction volume of the National Market in 2002 was 105 quadrillion TL. This figure accounted for 99% of the total trading volume in the Equity Market. In 2002, TL 818 trillion was processed in the Regional Markets and TL 336 trillion in the Detention Market.

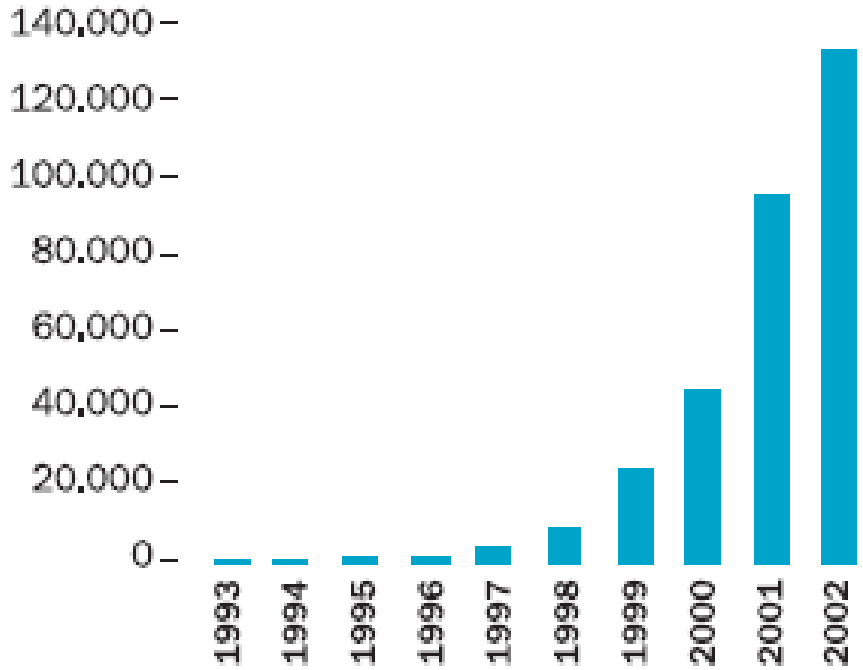


Figure 3.12: Daily average transaction amount (Million)

Source: Borsa İstanbul , 2002

The total market value of the companies traded on Borsa İstanbul, which was USD 47.7 billion, according to the closing prices on the last trading day of 2001, became USD 34.4 billion at the end of 2002. Total market value in TL terms decreased from TL 68.6 quadrillion to TL 56.4 quadrillion in the same period.

In 2013, the total transaction volume in the Equity Market was 814.7 billion TL (up by 24% to USD 430.1 billion), up 31% year-on-year.

The average daily trading volume of the Equity Market increased by 32% in 2013 compared to the previous year and reached 3.25 billion TL (an increase of 25% to USD 1.7 billion). The average number of daily contracts, which was 312 thousand in the previous year, was 314 thousand in 2013 and the average daily transaction volume increased by 15% in 2013 to 790.5 million.

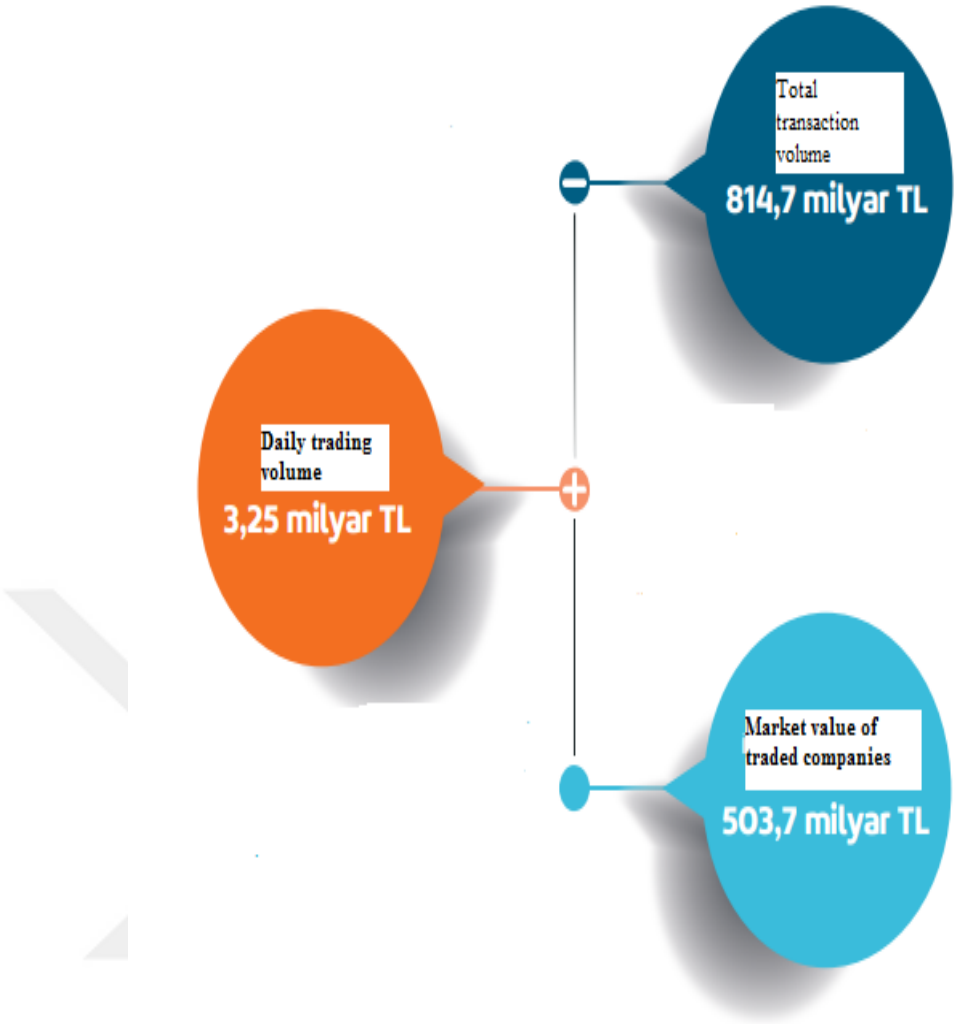


Figure 3.13: 2013 BIST Statistics

Source: Borsa İstanbul , 2013

The total market capitalization of the companies traded in the Equity Market decreased by 8.4% to TL 503.7 billion (USD 236.6 billion, down 24%) at the end of 2013 compared to the end of the previous year.

The transaction volume ratios of Borsa İstanbul between 1999 and 2018 on the based on individual and corporate and investor basis on the Turkish and foreign axis are given below.

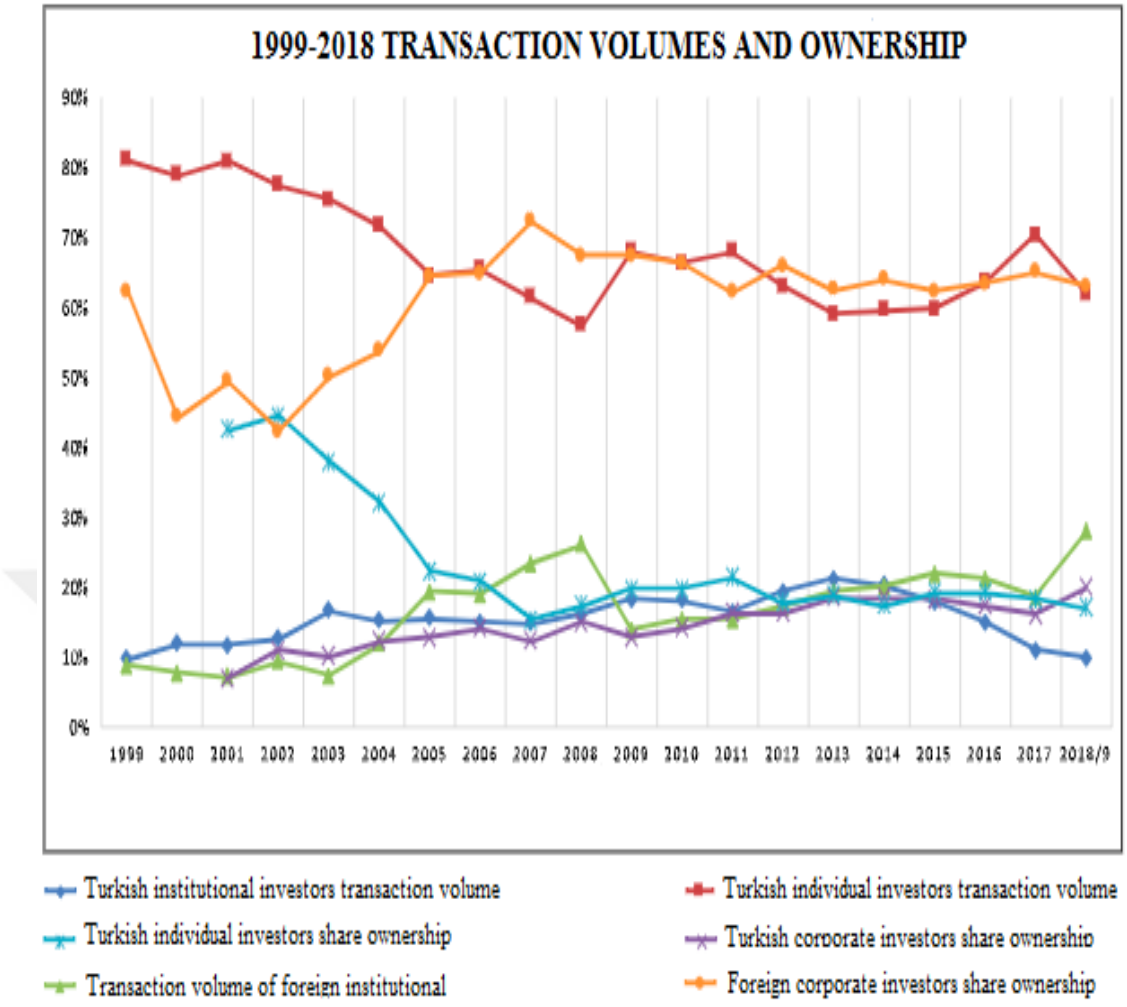


Figure 3.14: Transaction volume and ownership rates in Borsa İstanbul

Source: Borsa İstanbul , 2018

3.2. BIST 100 Index

BIST 100 index is used as the main index of Borsa Istanbul Stock Market. It consists of 100 stocks selected from more than 300 stocks traded on Borsa İstanbul. At the same time, the shares traded in BIST 30 and BIST 50 index constitute the BIST 100 index. The shares constituting the BIST 100 index are calculated from the shares of the 100 most valuable companies traded on the Borsa İstanbul. However, it is not a fixed index on company basis, ie the top 100 companies change from time to time. The return graph from 1987 to 2018 is given in Figure 3.2.

Figure 3.25: BIST 100 Index

Source: Borsa İstanbul , 2014

BIST 100 index, which was initially calculated weekly, started to be calculated daily starting from 1987. When we look at the annual returns of the index since 1987, we see that in the period between 1989 and 1999, three years were completed with a return of more than 400%, and in 1997 there was a very high return of 254%. In the 2000s, although relatively more naive returns were achieved, there are still years of high returns. Below you can see the returns of the BIST 100 index for the period 1987–2018.

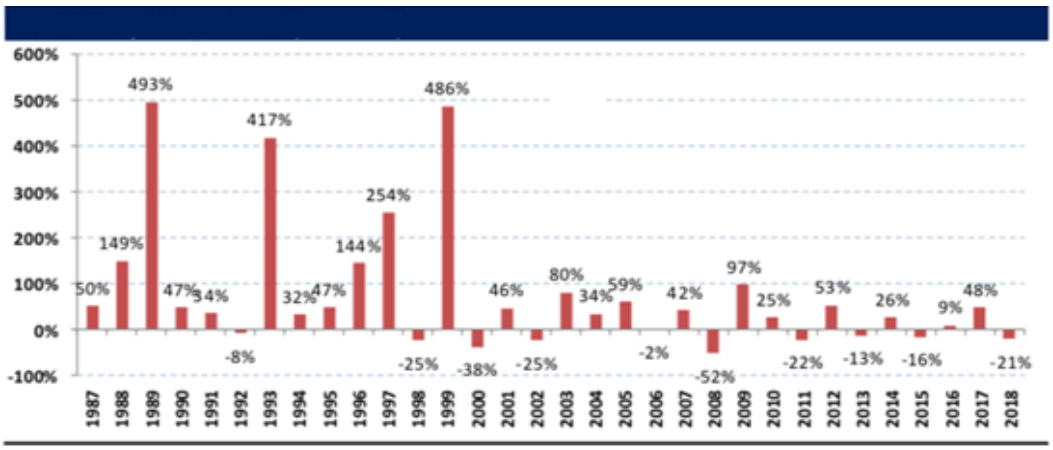


Figure 3.26: BIST 100 Nominal Annual Return (Nominal)

Source: Borsa İstanbul , 2018

Because it is struggling with high inflation in Turkey for many years, to return the form above also needs to look at the real return adjusted for inflation. Here, although fluctuating, we see that Borsa İstanbul, in general, provides investors with high returns above inflation.

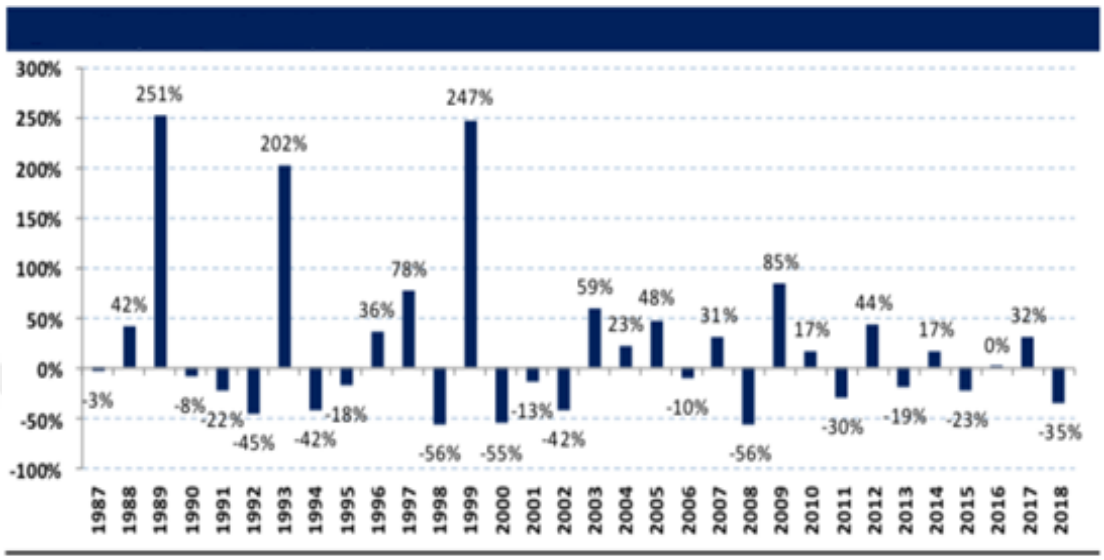


Figure 3.27: BIST 100 Annual Return (Reel)

Source: Borsa İstanbul , 2008

3.3. Fundamental Variables

3.3.1. Beta Coefficient

When analyzing investors' stocks, it is not enough to examine the stocks independently of the market, and it is also necessary to examine the dependence ratios, which are prizes. Beta coefficient (β) can be considered as a good indicator of this dependence (Bolak, 1990).

The beta coefficient is a coefficient that measures the sensitivity of any stock to fluctuations in the market index (Kaderli, 2001). This coefficient indicates the relationship between the changes in stock market bring-ups (Ceylan, 2004), depending on the changes in the rate of return of the market portfolio. That is, the beta coefficient, which is a constant risk indicator for any stock, is a mathematical coefficient that tries to explain the extent to which the stock's turnaround will vary relative to the stock market (Küçükkocaoğlu, 2003).

Sharpe's capital asset pricing model (CAPM) is generally based on a single variable. In this model, the market portfolio is accepted as an independent variable, and all risky securities are tried to be explained by the returns of the market index of returns. The beta coefficient also shows the relation of the return of security to the return of the market index. As it is known, according to this model, the return of a security depends on the total risk taken. This risk is also indicated by the standard deviation of the yield of that security. Since the market index is a highly diversified portfolio, the risk of the company, which is one of the two components of total risk in this portfolio, falls away completely, and only the market risk remains. For this reason, the beta coefficient shows only market risk (Karan, 2001).

According to the CAPM, the return required by an investor can be formulated as follows (Özçam, 1997).

$R_i = R_f + \beta_i (R_m - R_f)$

R_i = the desired rate of return from the stock,

R_f = Rate without risk,

β_i = systematic risk of stock, ie beta coefficient,

Rm = represents the expected return of the market index.

The beta coefficient of a stock can be calculated by dividing the covariance between its return rates and the market index return rates by the variance of the market return ratios. This relation can be shown by the following formula (Levy, 1996).

$\beta_i = Cov_{i,m} / Var_m$

Here

$Cov_{i,m}$ = how the stock index and the returns of the market index change together (covariance),

Var_m = indicates the risk (variance) of the returns of the market index.

When calculating the beta coefficient of a security with the specified formulas, the returns of the securities are usually used (Foster, 1978).

If the beta coefficient calculated by the formulas stated is greater than 1, the market index when a change of 1 percent occurs, there is a change in the rate at which the yield of the security is higher than 1 percent. Such securities are referred to as "attacks". If the beta coefficient is less than 1, it will change by 1 percent in the market index and less than 1 percent in the return of securities. Such securities are called "defender". If the beta coefficient is 1, the change in the market index and the performance of the security is the same. The returns of securities with negative beta coefficients are shown in the market indices. The rates are reversed. Such securities are described as "super-deaf"(Hirt, 2006). If the beta coefficient of a security is equal to 0, it means that the expected return on that security is similar to the risk-free interest rate (Durukan, 1998).

Information on how a share is affected by changes in the market index significantly influences the investor's decision on stock selection (Sarıkamış, 2000) . Therefore, the beta coefficient should be used in the selection of the stocks to be included in the portfolio, considering the anticipations about the changes that may come to the future in the market. If an uptrend is expected in the market in the future, the portfolio should be included in "offensive" stocks. If there is an expectation in the opposite direction, the stocks to be included in the portfolio should be "defensive" (Bekçioğlu, 2003)

Table 3.1: Interpretations of Beta Value

Value of Beta	**Interpretation (The index is used as benchmark)**
$\beta < 0$	The movement of the stock is opposite to direction of the index.
$\beta = 0$	The stock movement is not related to the index.
$0 < \beta < 1$	The stock moves in the same direction as the index but has less volatility than the index.
$\beta = 1$	The stock move in the same direction and the same amount with the index.
$\beta > 1$	The stock moves in the same direction as the index and in a larger amount.

For example, for the first quarter of 2002, the average return of each stock and the beta coefficient are calculated and given in the following table in ascending order. From 2002 to 2013, the average return and the calculated beta coefficients of the BIST 100 stocks, as well as all these 3-month tables, are the most basic input of my model testing the “Low Volatility Anomaly” (Beta Anomaly) to be used in our calculations.

Table 3.3.12: BIST 100 Index - 2002 1. Quarter

#	STOCK NAME	AVARAGE RETURN	BETA VALUE
1	USAS	0,28	0,20
2	MRDIN	-0,14	0,43
3	SASA	-0,09	0,43
4	ADANA	-0,22	0,46
5	ECYAP	-0,06	0,46
6	OTKAR	-0,78	0,48
7	ASELS	-0,14	0,52
8	KENT	-1,12	0,54
9	KIPA	-0,28	0,62
10	GRUND	0,03	0,63
11	ALKIM	0,05	0,63
12	BAGFS	-0,06	0,63
13	BOLUC	-0,27	0,64
14	CIMSA	-0,23	0,66
15	ANHYT	-0,42	0,67
16	ZOREN	-0,05	0,71
17	SANKO	-0,58	0,72
18	TEBNK	-0,11	0,72
19	PENGD	-0,32	0,73
20	ALGYO	-0,44	0,75
21	PRKME	0,58	0,75
22	MGROS	-0,40	0,75
23	AYEN	-0,41	0,75
24	KARSN	-0,62	0,77
25	TRKCM	-0,27	0,78
26	BRYAT	-0,30	0,79
27	ENKAI	0,29	0,79
28	TATGD	-0,50	0,79
29	AKSUE	-0,45	0,80
30	ASUZU	-0,39	0,80
31	YAZIC	0,19	0,82
32	TRCAS	-0,56	0,82
33	FROTO	0,09	0,82
34	ATEKS	-0,28	0,83
35	AKENR	-0,17	0,84
36	ECZYT	-0,44	0,84
37	AKGRT	-0,37	0,85
38	ALARK	-0,18	0,85
39	ANSGR	-0,40	0,86
40	GEDIZ	-0,73	0,86
41	AEFES	-0,10	0,86
42	IZOCM	-0,17	0,86
43	GOLDS	-0,24	0,86
44	TUDDF	0,06	0,87
45	SODA	-0,42	0,87
46	GIMA	-0,59	0,89

47	TOASO	-0,19	0,89
48	BOSSA	-0,33	0,90
49	AKSA	-0,47	0,90
50	GSDHO	-0,84	0,90
51	DYOBY	-0,54	0,90
52	UZEL	-0,19	0,91
53	ANACM	-0,15	0,91
54	DGGYO	-0,67	0,91
55	COMDO	-0,16	0,91
56	ECILC	-0,49	0,92
57	TUPRS	-0,80	0,92
58	PTOFS	-1,45	0,93
59	VESTL	-0,19	0,93
60	KAVPA	-0,55	0,94
61	ISGYO	-0,39	0,94
62	NETAS	-0,65	0,94
63	HEKTS	-0,38	0,95
64	EREGL	-0,28	0,95
65	ISCTR	-0,21	0,95
66	CLEBI	-0,46	0,95
67	IZMDC	-0,54	0,95
68	FORTS	-0,26	0,96
69	SAHOL	-0,36	0,97
70	PETKM	-0,39	0,97
71	METRO	-0,43	0,98
72	SISE	-0,43	0,98
73	KORDS	-0,25	0,99
74	KCHOL	-0,24	1,00
75	AKCNS	-0,05	1,01
76	BOYNR	-0,82	1,02
77	HURGZ	0,44	1,02
78	DEVA	-0,38	1,04
79	AYGAZ	-0,37	1,04
80	KRDMD	-0,33	1,05
81	NTTUR	0,02	1,05
82	ISFIN	-0,58	1,05
83	CEMTS	-0,47	1,06
84	EFES	-0,47	1,09
85	TNSAS	-0,31	1,10
86	YKGYO	-0,11	1,12
87	ALCTL	-0,25	1,16
88	ARCLK	-0,19	1,17
89	NTHOL	-0,18	1,17
90	AKBNK	-0,09	1,19
91	GARAN	-0,03	1,20
92	THYAO	-0,33	1,21
93	DYHOL	0,12	1,29
94	DOHOL	-0,01	1,30
95	FINBN	-0,79	1,30
96	YKBNK	-0,13	1,32
97	TCELL	-0,52	1,33
98	MIPAZ	0,27	1,34
99	GLYHO	0,02	1,34
100	DGZTE	0,64	1,51

Source: Borsa İstanbul , 2002

3.3.2. Average Return

The average return is the result obtained by dividing the sum of the data series summarized in the specified data interval by the data length. If the result is more significant than zero; it means that the average return is positive (a return is obtained), and if it is less than zero (no return is received).

3.3.3. Risk-Free Rate

The Risk-free rate is the rate of return demanded by investors for investments without risk. Basically, this return compensates the time value of money to investors. Inflation decides that future funds will not buy as much as it does now, and the risk-free rate pays investors compensation for the time their capital is tied. Commonly, Treasury rates are used as a measure of risk-free rates. It is often good practice to match the duration of the Treasury with the period of the average return. Alternatively, there are arguments that the most long-term Treasury should be used because stocks are uncertain investment means. What you prefer to use as a risk-free rate is not as crucial as staying consistent throughout the calculations. However, you must select a reasonable risk-free rate.

Table 3.3.33: Risk Free Rate By Annuals

YEAR	QUARTER	RISK FREE RATE
2002	1	63,92
2002	2	52,81
2002	3	50,93
2002	4	50,5
2003	1	46,98
2003	2	45,02
2003	3	38,23
2003	4	30,18
2004	1	25,33
2004	2	23,02
2004	3	21,67
2004	4	21,6
2005	1	20,55
2005	2	17,49
2005	3	17,23
2005	4	16,99
2006	1	16,37
2006	2	15,57
2006	3	17,66

2006	4	18,51
2007	1	19,23
2007	2	18,52
2007	3	18,45
2007	4	17,94
2008	1	17,12
2008	2	16,97
2008	3	18,64
2008	4	19,28
2009	1	16,78
2009	2	12,51
2009	3	12
2009	4	9,25
2010	1	9,09
2010	2	8,91
2010	3	9,31
2010	4	8,73
2011	1	8,17
2011	2	8,45
2011	3	9,69
2011	4	8,97
2012	1	10,93
2012	2	10,4
2012	3	10,54
2012	4	8,65
2013	1	7,83
2013	2	6,99
2013	3	7,63
2013	4	8,68

Source: The Central Bank of the Republic of Turkey

3.3.4. Treynor's Measure

The index developed by Treynor to measure portfolio performances is the same as the Sharpe ratio. However, to measure portfolio risk, Treynor chose the beta coefficient, the systematic risk indicator, instead of the standard deviation, which is the total risk indicator. This is because securities investment funds can eliminate non-systematic risk due to diversification and the possibility to be selected according to appropriate risk groups. Therefore, only the systematic risk represented by beta remains.

$$Treynor\ Index = \frac{(R_a - R_f)}{\beta_a}$$

In the formula, R_a represents the average return of the portfolio, R_f represents the average return of the risk-free interest rate, and βa represents the portfolio's systematic risk (beta). The equation systematically measures the excess return per unit of risk. An increase in the Treynor index means an increase in portfolio success.

3.4. Data

In this study, a 12-year data set of stocks traded in BIS 100 between 2002 and 2013 was used. Each year is divided into four quarters with 3-month return and beta values. Four tables for one year, including 100 stocks for each quarter, were prepared. Thus, for the 12-year data set, 48 tables are prepared, with the same fields, each consisting of 100 stocks, as in the following one table. Each table is sorted in ascending order by beta value.

Stock calculated Beta and Average Return and Risk-Free Rate values between 2002 and 2013 years are downloaded from Borsa İstanbul and each year divided into four periods, which is named first quarter, second quarter, third quarter, fourth quarter. In addition to this, Average Return, Beta, and Risk-Free Rate are calculated for each quarter.

3.5. Methodology

Borsa İstanbul BIST 100 stocks are ranked in ascending order according to the Beta coefficient for each quarter of the data set consisting of average return and Beta coefficient from 2002 to 2013. The number of stocks in the portfolio can be 5, 10, 20, 25, 50 in order to create a whole integer portfolio count within 100 stocks of the BIST 100 index. For this reason, this is also defined in my application.

So I tried to determine Low Volatility Anomaly (Beta Anomaly) by choosing periods of 1, 2, 3, 4, 12 years for the 12-year time interval from 2002 to 2013 with beta and return values belonging to quarterly periods at the BIST 100 at the portfolio level.

In practice, the return and beta values of the portfolio are calculated for each period, taking into account the 3-month return and beta values.

For the stocks traded at BIST 100 between 2002 and 2013, the sequence created in practice is as follows;

S_y : 12-year stock series on an annual basis

$\{S_y\}_{y=1}^{12}$=$\{Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8, Y9, Y10, Y11, Y2\}$

Y_q : The stock quartile of 4 quarters each year

$\{Y_q\}_{q=1}^{4}$=$\{Q1, Q2, Q3, Q4\}$

Q_s : Each quarter in ascending series, which consists of 100 stocks by beta value

$\{Q_s\}_{s=1}^{100}$=$\{S1, S2, S3, S4, S5, \dots \dots, S100\}$

Q_p : Each quarter sequence consisting of 10 portfolio

$\{Q_p\}_{p=1}^{10}$=$\{P1, P2, P3, P4, P5, P6, P7, P8, P9, P10\}$

P_s : Each portfolio consists of 10 shares

$\{P_s\}_{s=1}^{10}$=$\{S1, S2, S3, S4, S5, S6, S7, S8, S9, S10\}$

The following calculations are made for these generated portfolio sequences;

S_β : The beta value of shares in the portfolio

P_β: The beta value of the portfolio;

n : Number of shares in portfolio

$$P_\beta = \frac{\sum_{i=0}^{n} S_{\beta,i}^2}{\sum_{i=0}^{n} S_{\beta,i}}$$

S_{Pw} : The weight of the shares on the portfolio

$$S_{Pw} = \frac{S_{\beta,i}}{\sum_{i=1}^{n} S_{\beta,i}}$$

S_r : The average yield on three-month period in selected shares

P_r : The average return on the portfolio

$$P_r = \sum_{i}^{n} (S_{Pw,i} * S_{r,i})$$

S_{RFR} : Risk free rate in selected periods

P_t : Treynor ratio of the portfolio

$$P_t = \frac{(P_r - S_{RFR})}{P_\beta}$$

These portfolio values calculated with the selected annual period are recalculated by taking the average on the selected annual basis.

4. RESULTS

Based on the model established in section 3.5 Methodology, the average return and beta values of the ten stock portfolios, which are generated by quarterly data between 2002 and 2013, are calculated at 2, 3, 4, and 6-year periods.

If the portfolio consists of 10 stocks, and the annual period is selected as two years, we obtain 12/2 = 6 graphs.

First 2-year chart;

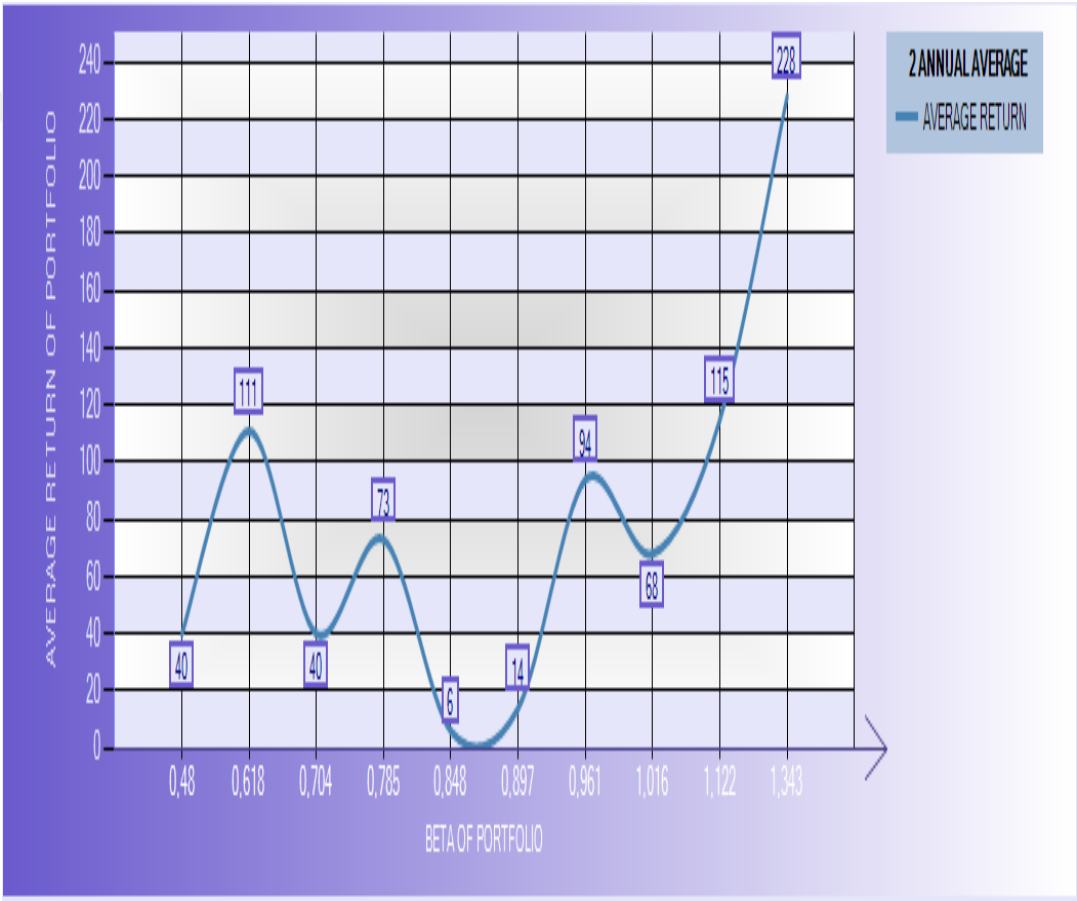


Figure 4.1: First 2-year chart

In this graph, it is observed that there is no linear relationship between the average yield and the beta coefficient up to 0.897. In other words, as the portfolio's beta increases, the average return of the portfolio decreases. However, after 0.897, the average yield of the portfolio increased as beta increased. The presence of Low Volatility Anomaly was observed up to half of the graph.

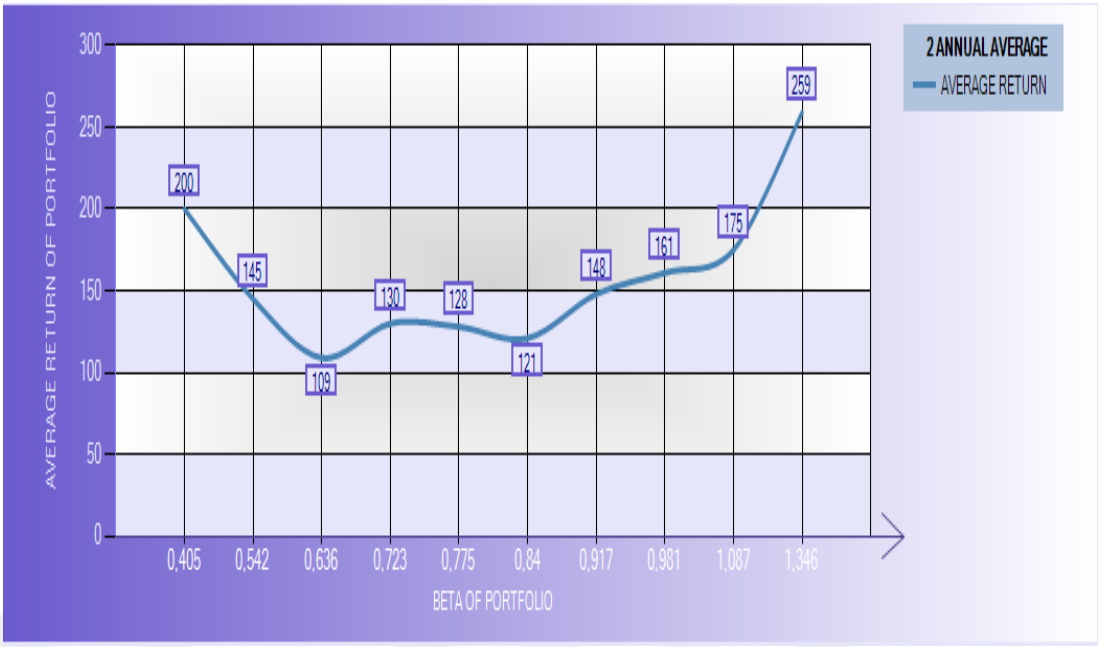


Figure 4.2: Second 2-year chart

In this graph, while Low Volatility Anomaly is seen to be half, there is a linear relationship between the average return of the portfolio and beta coefficient after half.

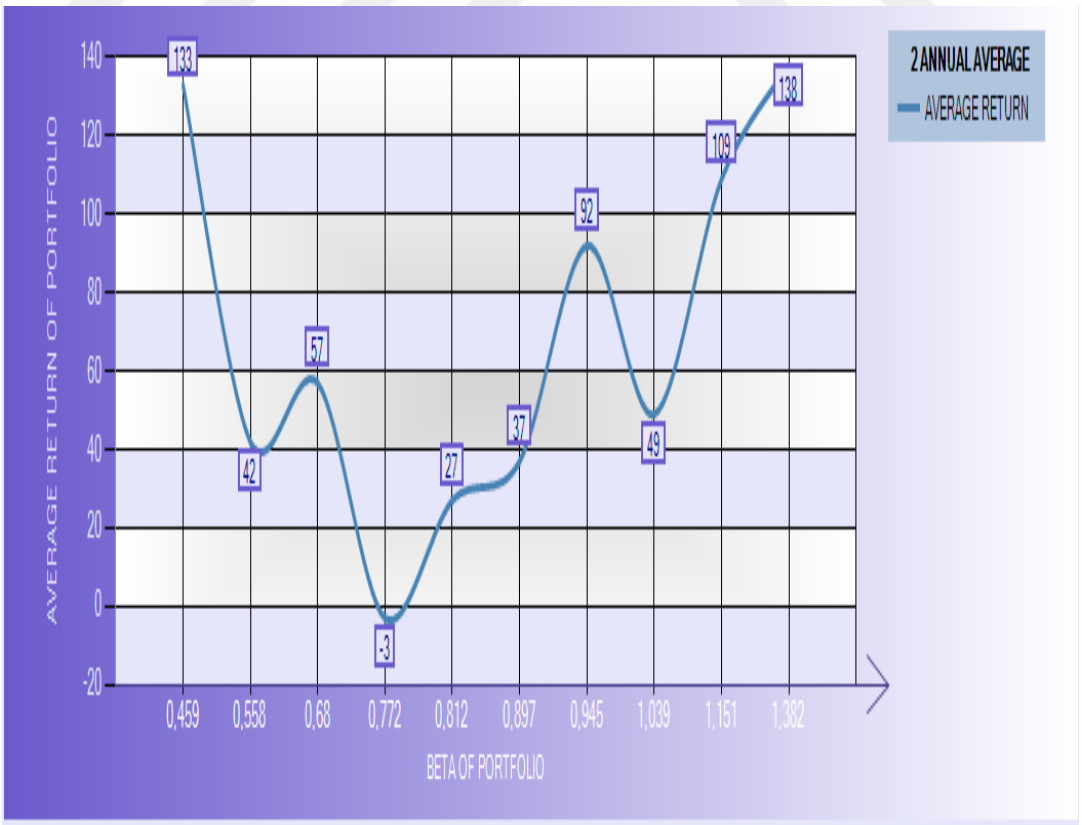


Figure 4.3: Third 2-year chart

In this graph, while Low Volatility Anomaly is seen up to 0.772 beta value of the portfolio, after this beta value, there is a linear relationship between the average return of the portfolio and the beta coefficient.

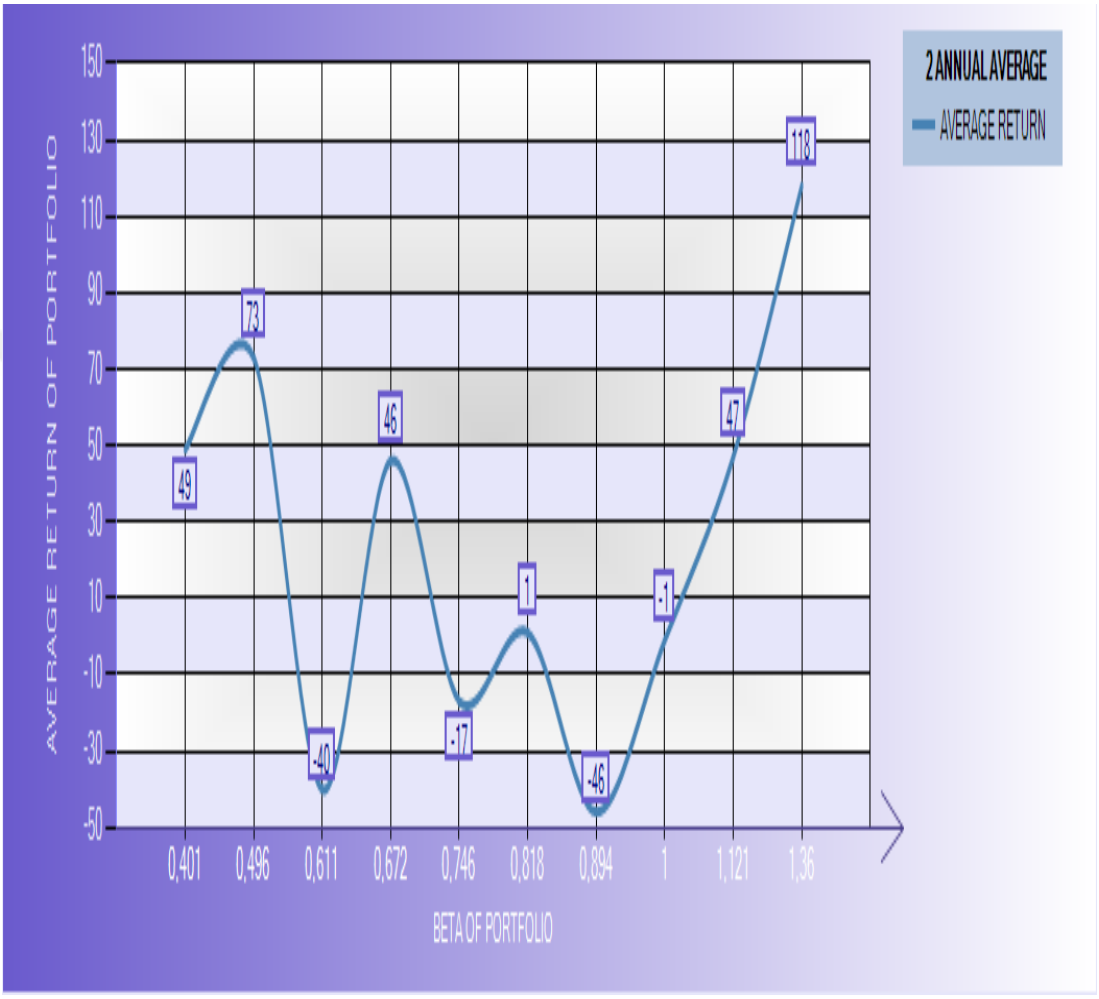


Figure 4.4: Fourth 2-year chart

Figure 4.4 shows a linear relationship between beta and average return after 0.894 beta value of the portfolio.

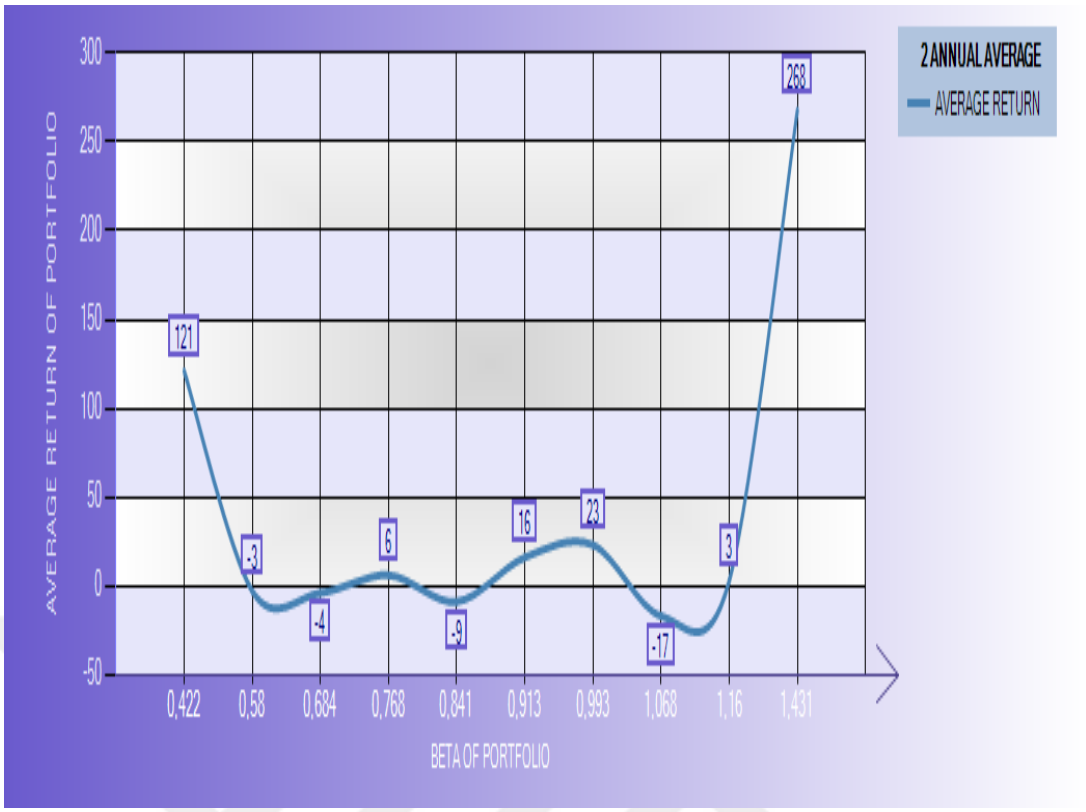


Figure 4.5: Fifth 2-year chart

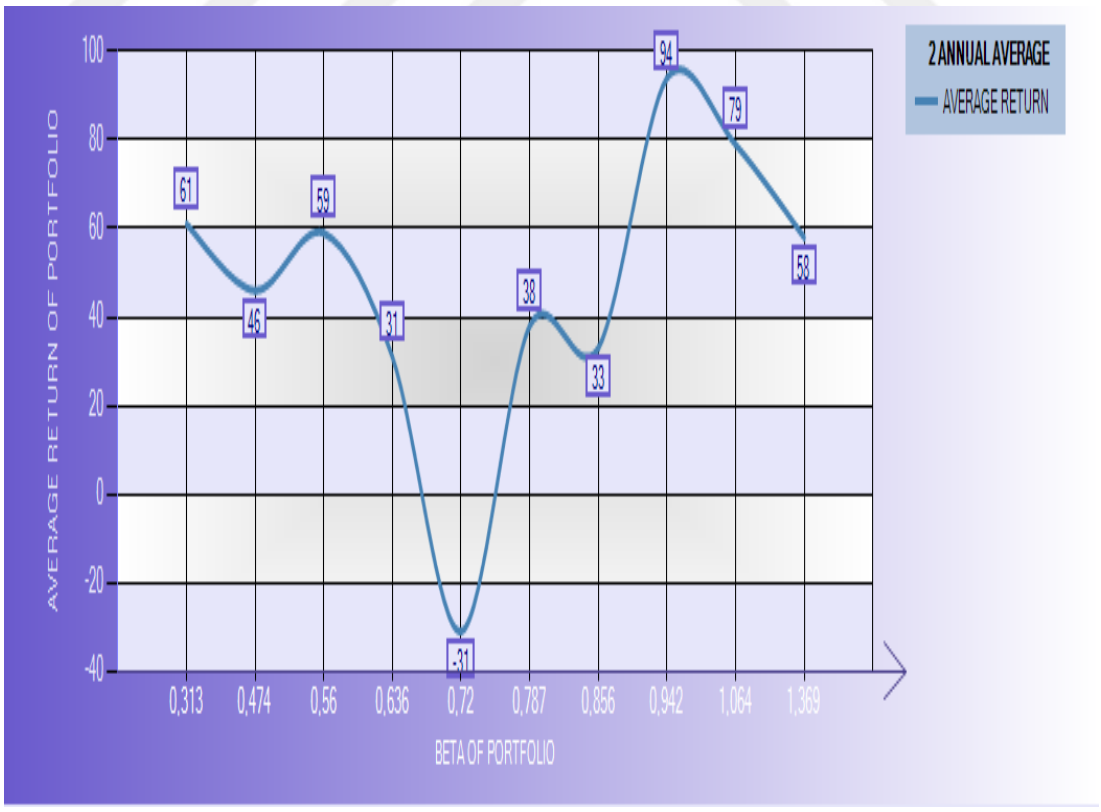


Figure 4.6: Sixth 2-year chart

The graph above shows a rapid decline in the portfolio's average return, up to 0.72 beta. But with a linear relationship between the beta and average yield of the portfolio, a rapid rise is observed.

If the portfolio consists of 10 stocks, and the annual period is selected as three years, we obtain 12/3 = 4 graphs.

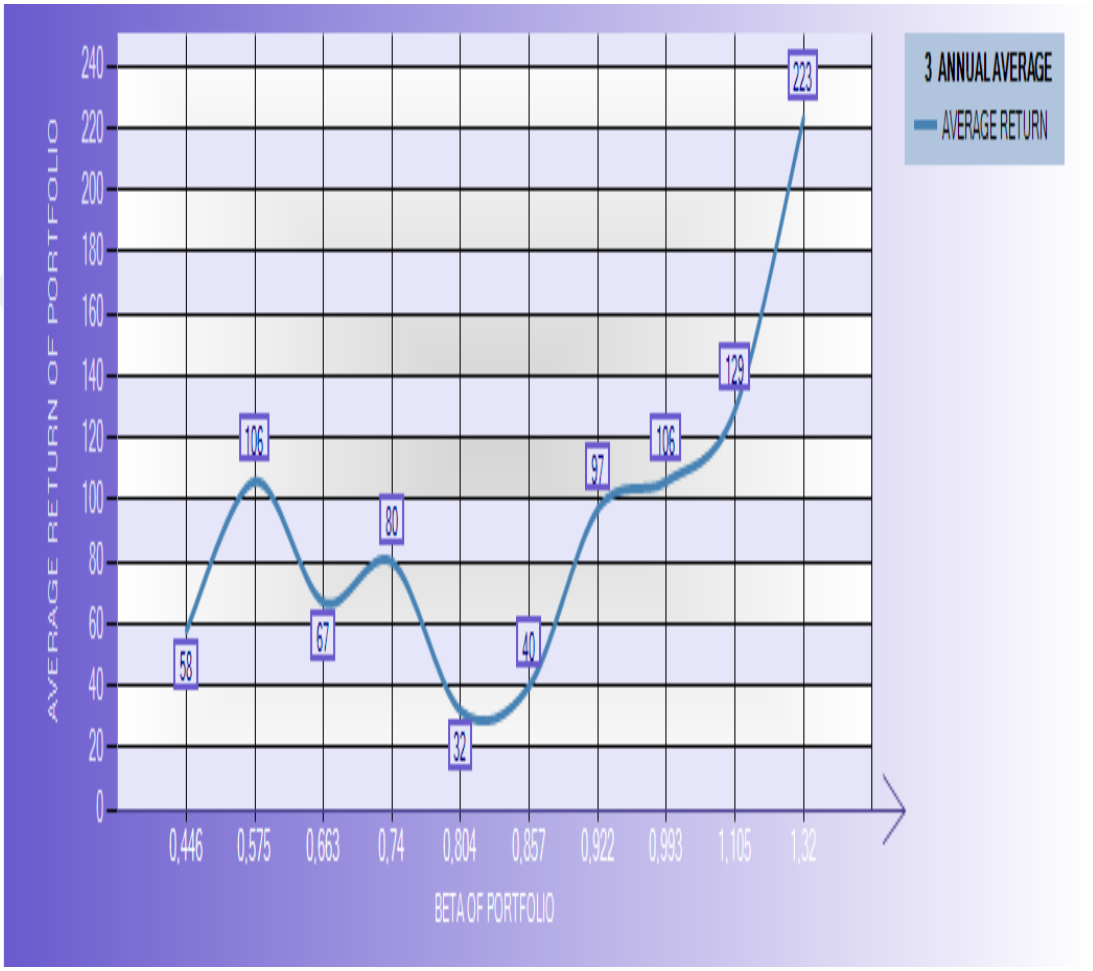


Figure 4.7: First 3-year chart

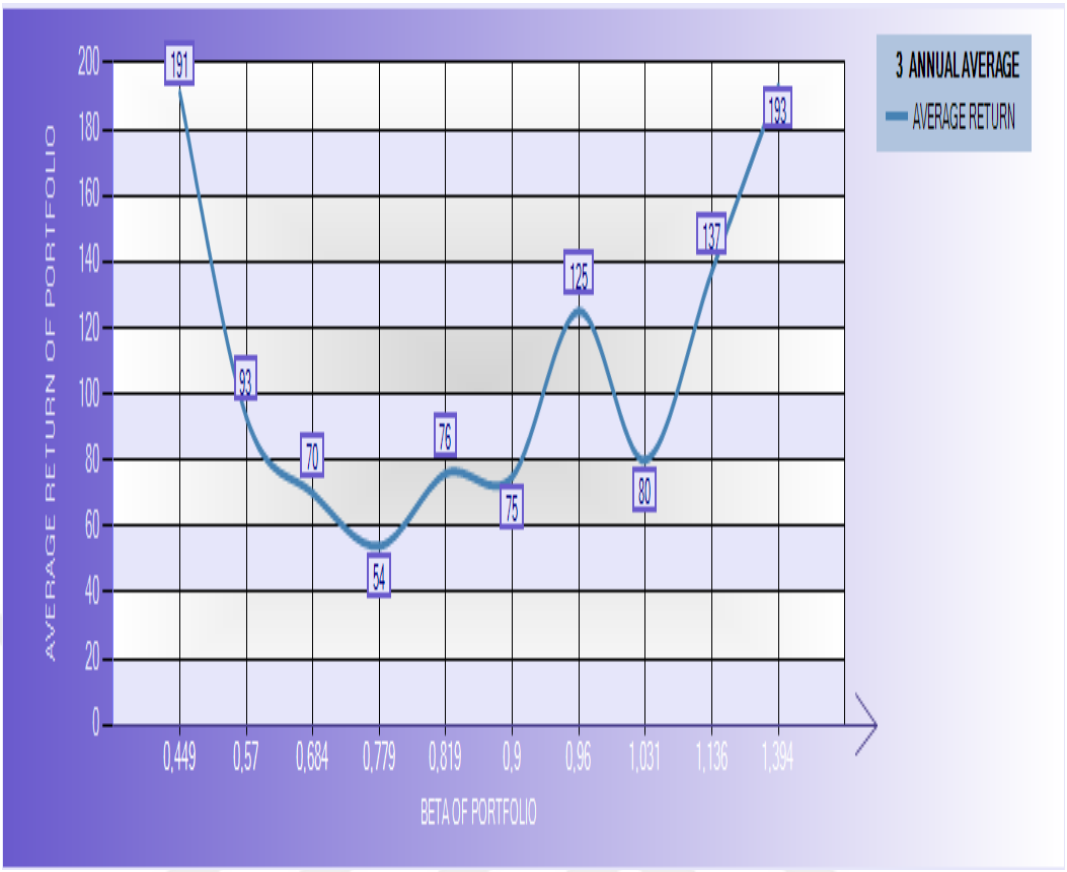


Figure 4.8: Second 3-year chart

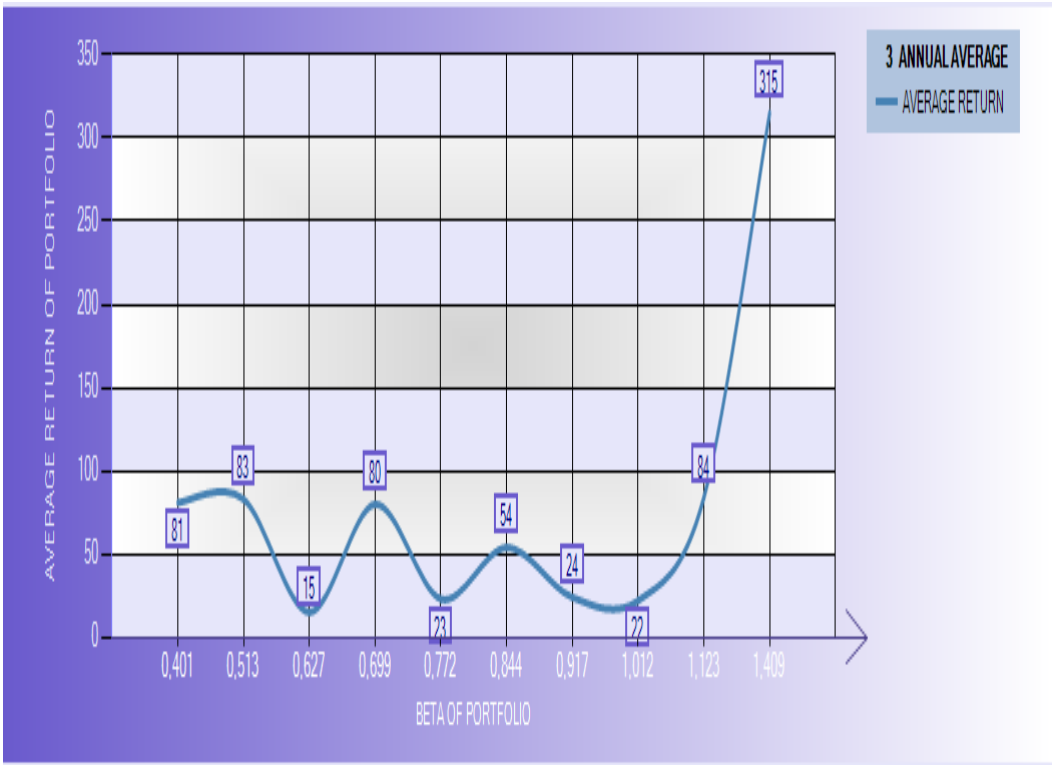


Figure 4.9: Third 3-year chart

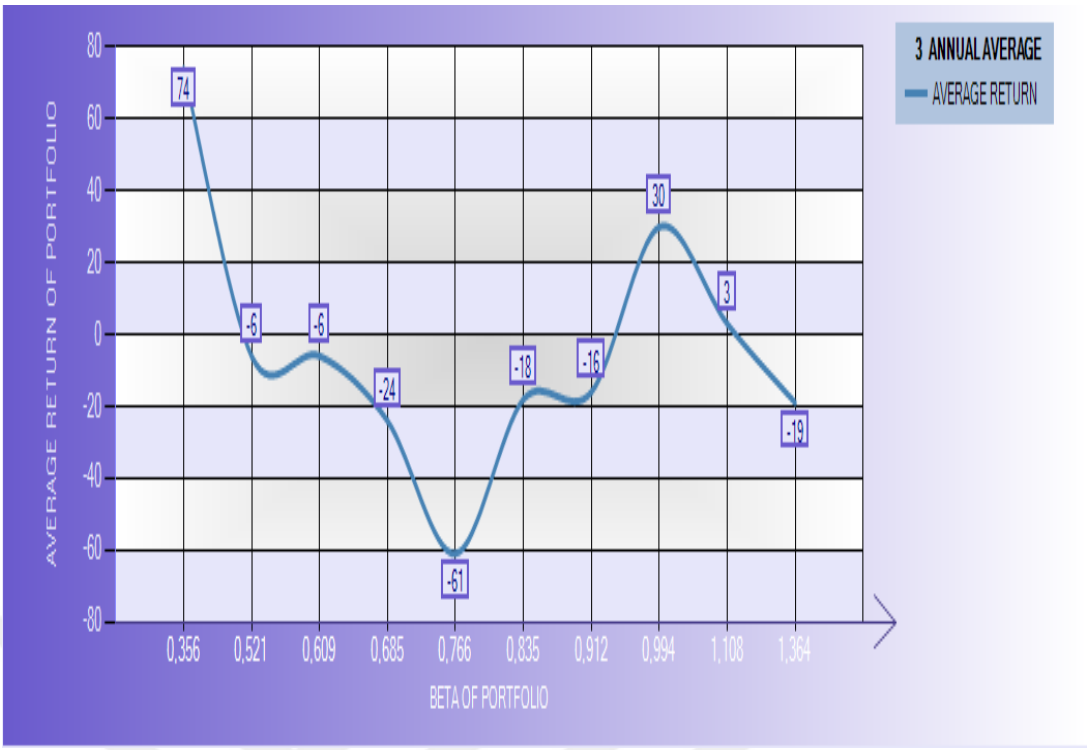


Figure 4.10: Fourth 3-year chart

If the portfolio consists of 10 stocks, and the annual period is selected as four years, we obtain 12/4 = 3 graphs.

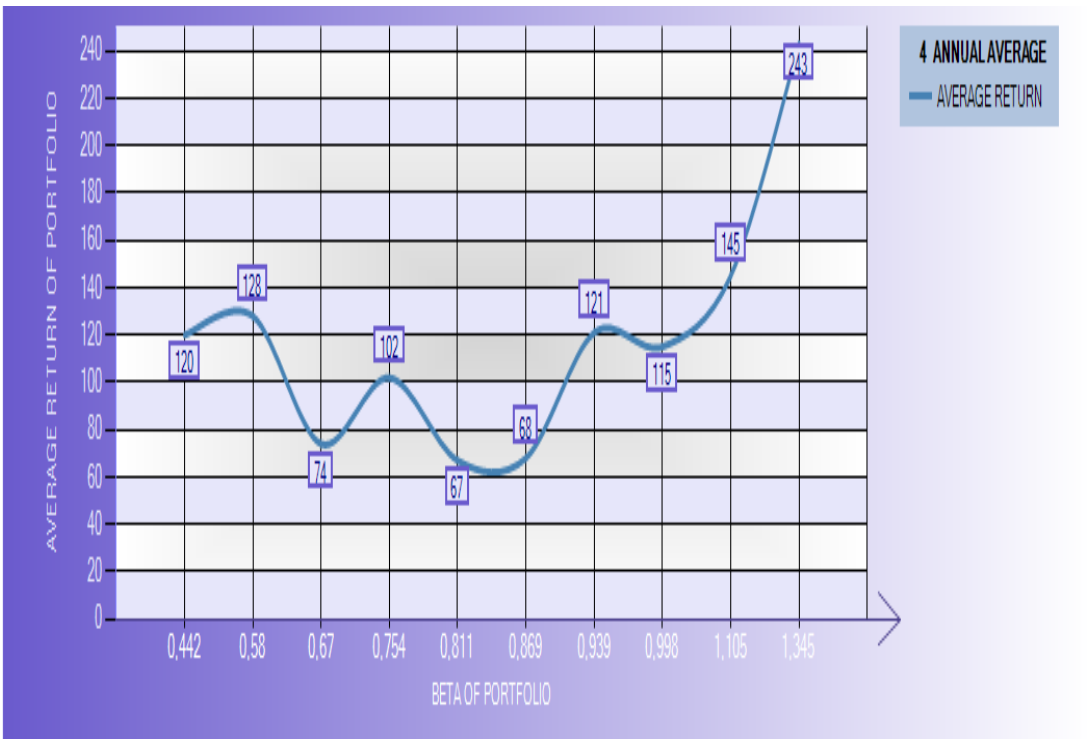


Figure 4.11: First 4-year chart

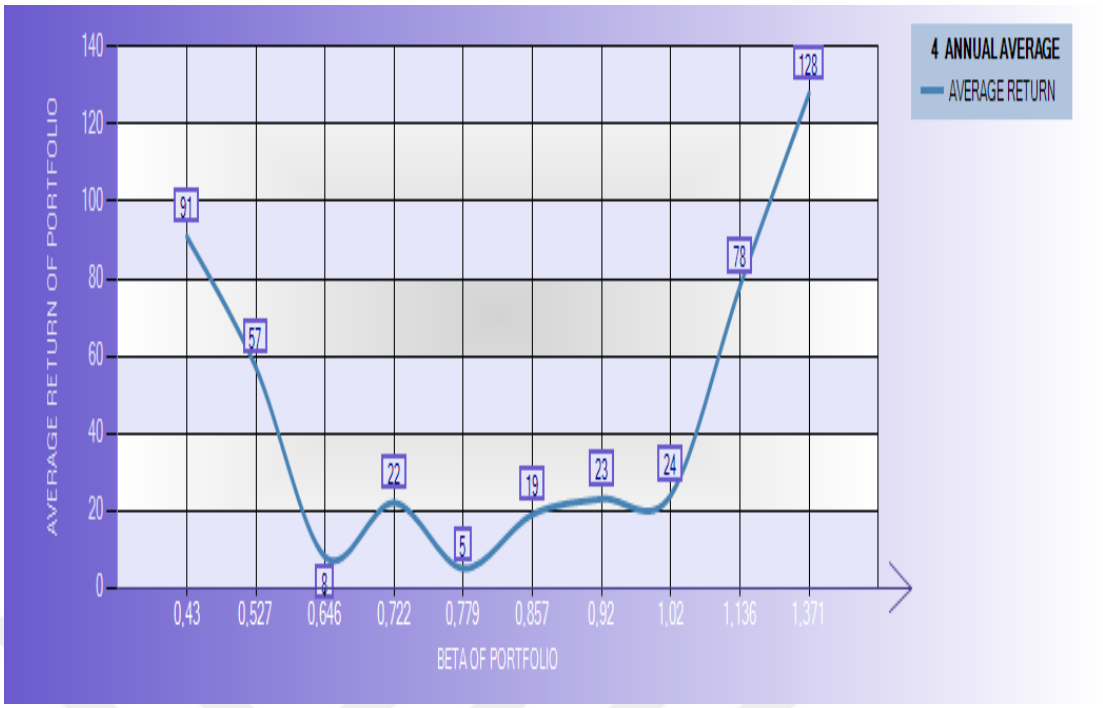


Figure 4.12: Second 4-year chart

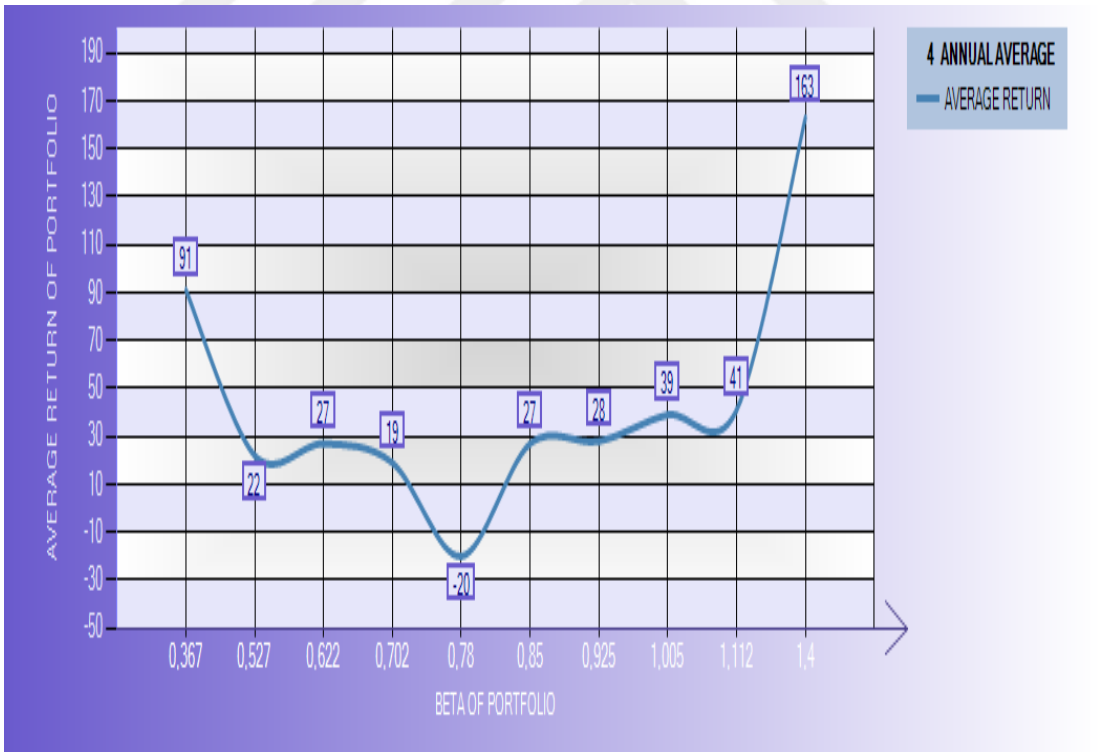


Figure 4.13: Third 4-year chart

If the portfolio consists of 10 stocks, and the annual period is selected as six years, we obtain 12/6 = 2 graphs.

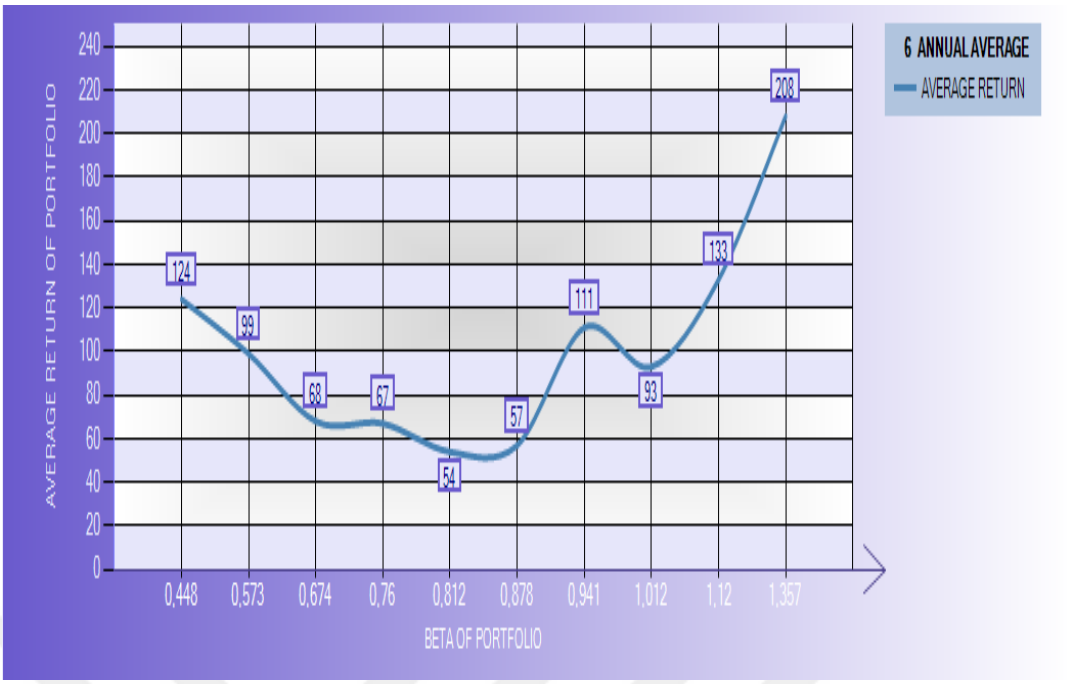


Figure 4.14: First 6-year chart

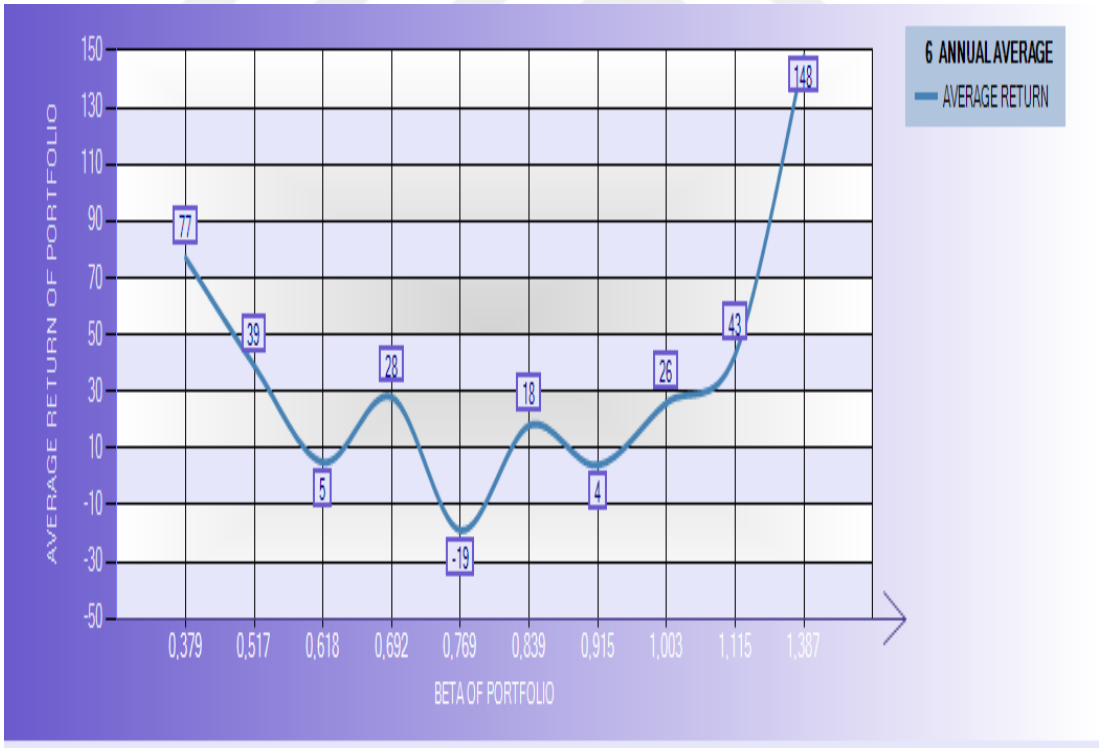


Figure 4.15: Second 6-year chart

If the portfolio consists of 10 stocks, and the annual period is selected as 12 years, we obtain 12/12 = 1 graphs.

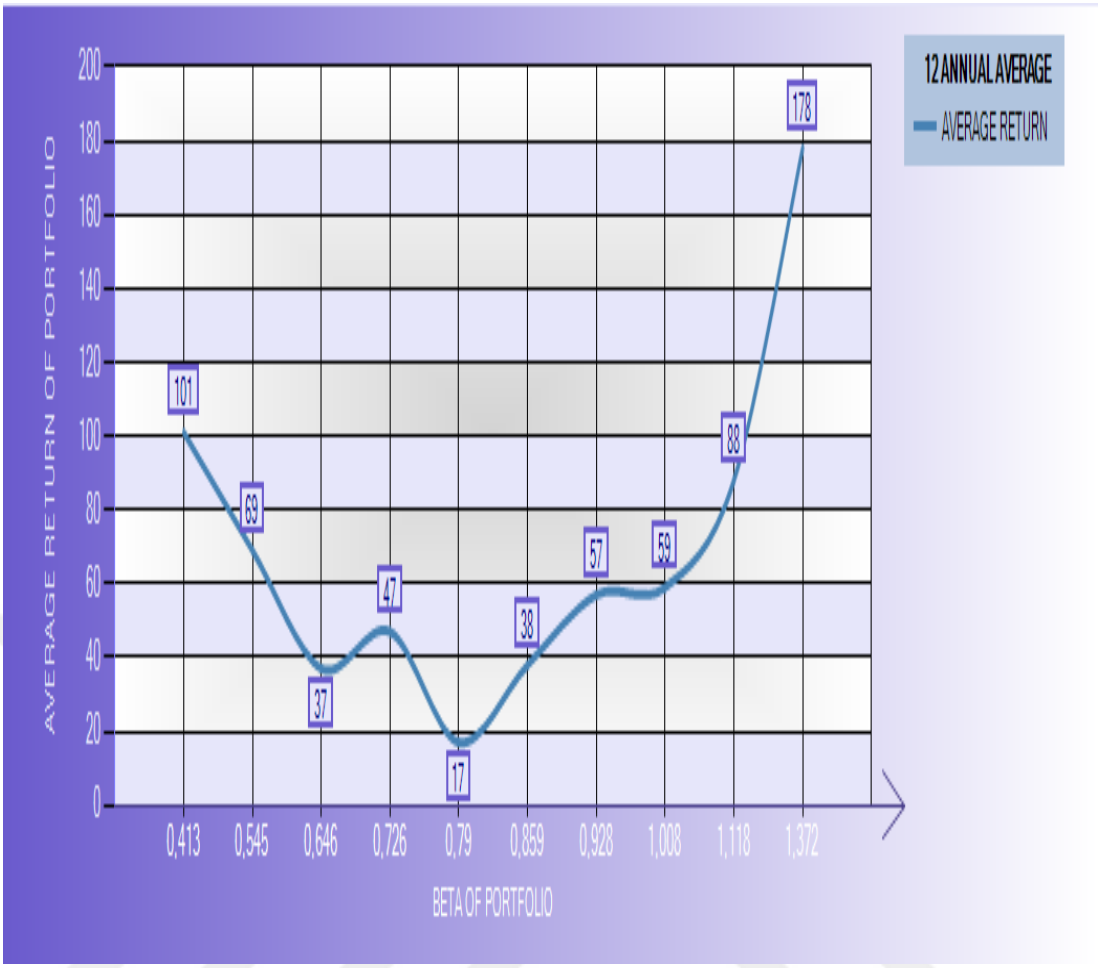


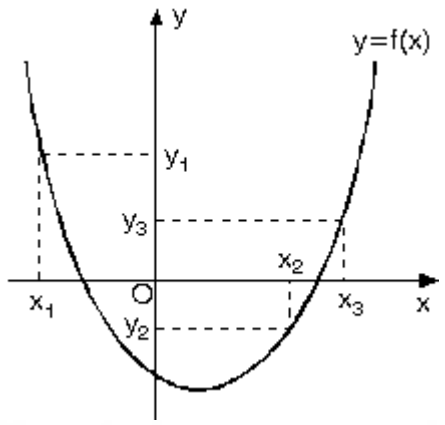
Figure 4.16: 12-years chart

The presence of Low Volatility Anomaly was determined in each of the 2, 3, 4, 6 years periods. In each graph, Low Volatility Anomaly was observed up to an average value of 0.80 of the beta of the portfolio. In other words, it is seen in almost all graphs that the portfolio's average return decreases as the beta of the portfolio increases. However, the linear relationship between beta and average return is also seen in almost all graphs. However, what is crucial for us is to detect the existence of Low Volatility Anomaly up to about 0.80 for all selected periods in the portfolio of 10 stocks. I also see that all the graphs of the portfolios created with 2, 3, 4, 6 years periods generally resemble a parabola curve.

y = Average return of portfolio

x = Beta coefficient of portfolio

y = f (x)



Thus, one side of the parabola shows "Low Volatility Anomaly", while the other shows the linear relationship between the beta of the portfolio and the average return. This means that as the risk of stocks up to the specific beta value of the portfolio, ie, the beta coefficient, the average return of the same portfolio decreases. However, after a certain risk value, this situation is the opposite in the same portfolio. In other words, as the beta coefficient showing the risk of the portfolio increases, the average return increases. At this point, we see both cases in all the graphs of the portfolios of the selected periods. Since my research is the determination of whether there is a finding of "Low Volatility Anomaly", yes I come across this finding in almost all the charts.

5. CONCLUSION

According to the basic principles of financial markets, the higher the systematic risk, investors expect higher returns. The finding that low-risk stocks yield more returns than high-risk stocks is one of the biggest anomalies in finance. This is called "Low Volatility Anomaly" in the financial literature. What I am trying to show in this thesis is to test the presence of "Low Volatility Anomaly" in Borsa İstanbul BIST 100.

In this thesis, I explicitly analyze “Low Volatility Anomaly” (Beta Anomaly) using Borsa İstanbul BIST 100 data. I investigate the relation between low risk and high return in the Borsa Istanbul BIST 100 index stock market for the period 2002–2013. I established the presence of beta anomaly in the selected period in Borsa İstanbul BIST 100 index with the methodology by recursive calculation of the return and Beta coefficients for portfolios, each consisting of 10 stocks in specified periods (2, 3, 4, 6 years).

This is a surprising result according to the high risk-high return principle in financial markets. Regarding future research, my findings have implication for research that attempts to explain the reasons behind “Low Volatility Anomaly” (Beta Anomaly).

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